Ollscoil na hÉireann, Gaillimh
National University of Ireland, Galway

Repeat Examinations, 2008/2009

Exam Code(s)	4IF
Exam(s)	B.Sc. Information Technology
Module Code(s)	CT420
Module(s)	Real Time Systems
Paper No.	1
Repeat Paper	yes Special Paper
External Examiner(s)	Dr. John A. Keane
Internal Examiner(s)	Prof. Gerard Lyons
	Dr. Hugh Melvin

Instructions: Answer Q1 and **any other** 3 questions. All Q carry equal marks.

Duration	3 hrs
No. of Answer books	1
Requirements:	
Handout	
MCQ	
Statistical Tables	
Graph Paper	
Log Graph Paper	
Other Material	
No. of Pages	4
Department(s)	Information Technology

Q1. (i) Distinguish between the Sample Time and Response Time of a Real Time System (RTS) and show how they are related. Use a Flight Control System to illustrate your answer.

[15]

(ii) Distinguish using examples between a Hard and Soft RTS. Explain why many Hard RTS use a cyclic executive approach to scheduling whereas many Soft RTS utilise a RealTime Operating System.

(15)

(iii) Write a brief note on the general requirements of a programming language to be used in a Hard RTS and explain why Ada is commonly used.

(10)

Q2. (i) Distinguish between **time and timing** synchronisation and explain using examples why both can be important for both Hard and Soft Real Time Systems.

(20)

(ii) As a network administrator, you need to ensure that all servers within your Local Area Network are tightly synchronised to within 5 msec. Briefly sketch and describe your design for an NTP subnet to meet this requirement, commenting on all relevant issues (Stratum sources, redundancy, OS platform, network issues etc). Show how network asymmetry can seriously degrade NTP performance

(20)

Q3. (i) Briefly compare and contrast the Cyclic Executive approach and Multiple Process approach to scheduling for Real Time Systems, commenting on where each might best be deployed.

(15)

(ii) Describe the Rate Monotonic Scheduling Algorithm and outline the general schedulability test.

(5)

(iii) Given the Task details in the attached table, determine using the general schedulability test and (if necessary) the detailed schedulability analysis whether the Task set are RM-schedulable. Confirm your result by completing a timeline analysis.

(20)

Task	e	p
T1	1	5
T2	2	5
T3	5	15

Q4. (i) Describe what is meant by POSIX and describe some of the principal POSIX.4 features that are important for RTS development. Explain also how they might be implemented in code.
Use an example of a Flight Control System to illustrate your answer (30)

(ii) Outline briefly what distinguishes a RealTime Operating System from a conventional Operating System, making reference to the role of POSIX.
[10)

Q5. (i) Outline in detail the four main causes of RTS failures, both from a software and hardware perspective. Comment in particular on the role of the operating environment using an aircraft as an example.

(15)

(ii) Hardware and Software redundancy are key elements in the design of Hard RTS. Describe what is meant by N-Modular redundancy (NMR) and Static Software redundancy. With regard to NMR, what reduction in failure probability can be achieved by utilising a 2v3 system where each individual component has a failure probability of 0.001. (0.1 %) .

(15)
Describe and sketch the key redundancy features of the Boeing 777 Primary Flight Computers (PFC)
(10)

Q6. (i) Describe briefly how the RTP protocol deals with some of the shortfalls of UDP as a transport layer protocol.

(10)

(ii) Outline also how the RTCP SR protocol can be used to implement lip synchronisation for voice/video multimedia streams.

(15)

(iii) Outline briefly the main Mouth-to-Ear (M2E) delay components for Voice over IP.

(15)